

Scytonema penicillatum, Ag.

Ferguson!

Geogr. distr. Blekingia.

Lyngbya majuscula, Hook.

Harvey! No. 84.

Geogr. distr. Mauritius, Socotra (*Balfour!*), Europe, North America, Bermuda, Martinique.

Trichodesmium erythræum, Ehrenb.

Ferguson!

Geogr. distr. Red Sea, Indian Ocean, Chinese Sea.

Hyphæothrix confervæ, Kütz.

Ferguson!

Geogr. distr. Germany.

Cylindrospermum macrospermum, Kütz.

Ferguson!

Geogr. distr. Throughout Europe.

IV.—*Contribution to the Knowledge of the Land-Planariæ.*

By Dr. D. BERGENDAL*.

IN the orchid-house of the Botanic Garden in Berlin some *Bipalia* were observed last autumn. These have since greatly multiplied there, and I have made a careful investigation of them in the Berlin Zoological Institute. In 1878 Moseley described † *Bipalium kewense* from the hothouses of Kew Gardens. The form here observed seems to be identical with this, although the ground-colour of the back is usually more of an olive-green and the streaks are almost quite black. The head is comparatively small, with a dark crescent upon the upper surface. The mouth is situated further forward than in most other *Bipalia*, at the anterior end of the second third of the body. The animals found are all without any developed sexual organs. Only in one animal have I been able to interpret some small aggregations of cells in the sections as the rudiments of testes. Of the oviducts and *vasa deferentia* I have never observed any traces. In other *Bi-*

* Translated from the 'Zoologischer Anzeiger,' No. 249, April 18, 1887, pp. 218-224.

† Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 238.

palia an external sexual orifice can be easily detected even in small individuals; but in this case I have never succeeded in doing so even in larger animals. About 1 centim. behind the mouth one sometimes sees a slight impression, which perhaps might be regarded as an indication of this aperture.

The creeping movement of the worms is effected almost exclusively by the long and strong cilia which clothe the sides of the creeping-sole. The middle of the margin of this is set with short strong cilia, which, however, move very feebly. When creeping the worms are almost cylindrical; in fact the dorso-ventral axis is even longer than the transverse axis.

Multiplication by Transverse Division.

The number of sexually immature animals has greatly increased in the conservatory. Even in the autumn a great number of small worms were to be observed. Close examination showed that many of these presented no heads, and that in others the development of the heads was very unequal. Animals which were cut with a pair of scissors into several pieces did not die, but each piece formed a new head and mouth. In the renewal of the head a white point is first of all developed, and this gradually enlarges. At first the streaks of the body can usually be traced on to the young head-lobe. With the development of the papillæ and eyes the typical pigmentation also makes its appearance. The renewal of the pharynx can be noted from without during its progress by the fact that the middle dorsal streak becomes widened over the spot where the mouth is being formed.

I have also observed spontaneous transverse division. Three times animals from which I had cut away cephalic portions of considerable size constricted off corresponding pieces from the posterior extremity, and all the three pieces afterwards became regenerated. Once, under such circumstances, two posterior pieces were thrown off. On separating a *smaller* anterior portion I have observed no posterior abstriction; nor does such a thing always occur when larger pieces are cut off. It would seem that this depended upon whether the animals had been previously well nourished. These worms also divide without having received any external injury.

These *Bipalia* are generally found in the reversed pots upon which the pots with plants stand; and I once found in such a pot three pieces which had been produced from one worm by transverse division. The plants had not been moved for a fortnight or three weeks, and the fissional cic-

trices and the course of the streaks showed that the divisions had taken place at the utmost two days before. That all the three pieces were together in the same pot also makes it quite certain that the divisions had occurred recently and spontaneously. The cephalic and posterior portions were of equal length. In these divisions therefore the definite position of the mouth must be of great importance. When posterior pieces are cut away, however, no anterior abstrictions occur. The histological phenomena of regeneration cannot here be discussed.

The great quantity of small portions of worms which have been observed in the conservatories, although some of these, of course, are formed by injuries, show that these phenomena are by no means of rare occurrence, and therefore we find among the *Land-Planariæ* the same asexual mode of increase which has recently been demonstrated in the case of the freshwater forms.

The Excretory Vascular Apparatus.

Metschnikoff has already described two longitudinal trunks in *Geodesmus*. On the other hand, von Kennel has since investigated the same animal, and believes that the excretory canals are only vacuities in the parenchyma, and hence he regards it as a matter of course that in sections nothing can be seen of the few flagelliferous cells. Von Kennel's observations, however, seem chiefly to relate to the freshwater *Planariæ*; in these Lang and Iijima have since found regular excretory ducts.

The pigmentation and the numerous bacilli of the *Land-Planariæ* have hitherto hindered the study of this apparatus in the living animal. The heads in course of regeneration and still unpigmented, however, furnish a pretty good opportunity for such observations, which may also be made on the ventral surfaces of worms which have been divided by a horizontal cut with a pair of sharp scissors. Crushed preparations, which may be observed in weak solutions of chloride of sodium, also furnish very good results in favourable cases.

Hitherto I have been able to establish the following facts. The apparatus presents:—(1) ciliated funnels with a very strong flicker; (2) irregular but reticulated canals; and (3) longitudinal trunks. The last-mentioned are slightly undulated and are situated to the number of two or more on each side, dorsal and lateral to the ramifications of the intestine. Ventral longitudinal trunks have also been observed. The longitudinal trunks consist of large perforated cells and

exhibit thick cilia, the tuberculiform basal parts of which give the walls a reticulate appearance. From the longitudinal trunks issue straight transverse canals, which may be in part discharging and in part collecting canals. From the conditions found by Lang in *Gunda* we should expect a regular arrangement of these; but hitherto I have been unable to recognize it, although the small number of such transverse canals is decidedly in favour of it.

The longitudinal trunks are so deeply seated in the parenchyma that they can scarcely be observed except in sections. The reticular canals and the ciliated funnels, on the other hand, must be studied in the living tissue. In the head we see, both on the dorsal and the ventral side, a great number of canals situated near the surface, which run in curves or reticulately, and sometimes form nearly coil-like loops. In these canals I have frequently seen structures which I must for the present interpret as strong ciliations. They resemble the "flammæ vibratiles" which Francotte has described in *Derostomum* and *Monocelis*. Metschnikoff also states something of the same kind with regard to the longitudinal canals of *Geodesmus*. I cannot regard them as phantasms produced by ciliary movement, because they are only to be seen here and there and because in crushed preparations I believe I have seen in exposed aquiferous vessels very long protoplasmic tongues pointed at both ends. They sometimes appear more membrane-like, and are then attached to the wall of the vessel by one margin. However, they can hardly represent those described by Francotte in *Polycelis*.

With the reticular canals the ciliated funnels are connected by very narrow longer or shorter canals, in which usually no phenomena of movement occur. The ciliated funnels are often placed in pits in groups of three or four together, and they present a large rounded excretory cell in which I have repeatedly observed vacuoles which emptied themselves into the funnel. Almost always there are ciliated funnels in the marginal papillæ of the head. I hope to be able hereafter to complete these exceedingly troublesome observations.

The Nervous System and Sense-organs.

Moseley regarded the nerve-trunks as a "primitive vascular system," but nevertheless believed that the nerves traverse them. Graff, von Kennel, Lang, and Iijima have shown that they are true nervous cords. In our *Bipalium* the sections of the nerve-trunks situated beneath the ramifications of the intestine are oval in transverse slices, and show a difference

of structure in different parts. In some places we see the septal (*Balkenbildung*) formation which is so much referred to; in others, the longitudinally running nerve-fibrils, cut across, are very distinct. Between these longitudinal trunks there are transverse commissures, which are very thin and often branched, which is probably the reason why Moseley and von Kennel did not see them. In older specimens, preserved in alcohol, of *Bipalium diana*, from the Zoological Museum in Berlin, I have also found these commissures. Near the head such commissures are particularly numerous. Further, strong arched nerves are emitted outwards, and these form a plexus under the skin. This plexus cannot be found everywhere; it is particularly well developed in the head and the fore part of the body. Such peripheral branches often start from the same spots as the transverse commissures, and at some of these points of ramification the dotted substance and the ganglion-cells become so numerous that one might almost describe it as a ganglion-formation*. No thickening of the longitudinal trunks was, however, observed. The ganglion-cells are large, have very large nuclei which stain rather faintly, and show two or three processes. The longitudinal nerves decrease very much in size in the caudal extremity; they curve towards one another and unite. In the cephalic portion is situated the flat and greatly extended brain, the formation of which by the union and thickening of two longitudinal trunks is to be recognized particularly distinctly in the hinder part of the brain. In the lateral portions of the brain we see great masses of dotted substance in transverse sections. Numerous ganglion-cells also occur in the brain, but their arrangement in the different parts cannot be described without figures.

Moseley has already stated that there are on the anterior margin of the head some papillæ, between which there occur little pits furnished with cilia. These papillæ, which are situated in a groove, are square in transverse section in *B. kewense*, and show an epithelium of rather small cells. The anterior surface of the papillæ is not beset with movable cilia; the lateral surfaces bound the passages leading to the pits and exhibit very strong cilia. The tissue of the papillæ consists in great part of muscular fibres, which give the papillæ great mobility. It is remarkable that we see in the papillæ no large nerve-trunks, nor is there any structure of the epithelium which would seem to indicate that they are sense-organs. The epithelial cells

* Iijima states that he found ganglia in the freshwater *Planariæ*, but that they possess but few ganglion-cells.

usually stain very strongly, and hence they cannot be well investigated. The observation of the living animal, however, fully establishes the interpretation of these papillæ as tactile organs.

In the above-mentioned pits, which are nearly spherical, the epithelial cells are much smaller, but they also stain strongly and can scarcely be washed out. From the anterior part of the brain, which rather forms a nervous plexus, strong nerve-branches run to the pits. The nerve-fibrils become thicker, and immediately beneath the pit we see a club-shaped bundle of long spindle-shaped and bacillar terminations of fibres. From these, small prolongations, which are of capillary fineness even under very high powers, run outwards between the cells of the epidermis. How they behave when there I cannot yet say. They are not connected with the rather strongly vibrating cilia which occupy the bottoms of the pits. Around this nerve-mass are placed larger, curved, fibriform granular structures, which pass to the lateral epithelial cells of the passages leading to the pits and agree in their appearance and reactions with the secretion-products of the glands. Motile cilia can hardly perhaps be interpreted as nerve-terminations, and therefore it seems probable that there are sense-hairs in the bottom of the pits among the cilia. The groups of strongly motile cilia of the freshwater *Planariæ* discovered by von Kennel have been regarded by Iijima as tactile organs, which can hardly be correct. They seem, however, to agree with these pits in *Bipalium*, and ought, perhaps, to be interpreted as olfactory organs or organs of taste.

Eyes occur in this species in enormous numbers. They form a zone of three or four rows near the margin of the head, and are also placed on the sides (not on the back) of the whole body, even to the hindermost end. The largest eyes are situated just behind the head. The eyes nearly agree in structure with those of the other Tricelades. The crystalline cone is formed in the same way of several nucleated clavate cells. The nucleus seen by Moseley in the hindmost part of the eye belongs to the pigmentiferous cell. Nerves run to the eyes from the superficial nerve-plexus. Sometimes I have observed a gangliform enlargement beside or in front of the eyes.

As regards other organs and structural conditions, I give here only the following remarks:—The whole body is provided with cilia. Between the ordinary epithelial cells we see here and there groups of slenderer bacilliform cells which may possibly be sense-organs. The rhabdites are of two

kinds, as I may remark in opposition to Iijima. Most of them are small and fusiform, but a good many are filiform, and more or less rolled up together. The two kinds are found together in the same cells, and both are also thrown off, for which reason I cannot regard them as developmental stages. As already stated, the bacilli are expelled under strong irritation, as, for example, when the animals are placed in Müller's solution, picric acid, picro-sulphuric acid, or chromic acid. In hardening them in corrosive sublimate, hot alcohol, or osmic acid, only the tips of a few bacilli usually make their appearance.

The musculature consists of an external layer of ring-muscles, external bundles of longitudinal muscles, and a great many internal longitudinal muscular fibres, to which are added dorso-ventral and transverse fibres.

In passing, I may state here that in *Bipalium diana* I have observed an encysted Nematode. In the unpaired limb of the intestine there was far forward the radula of a Gastro-pod. I can confirm von Kennel's statements as to the occurrence and the mode of opening of the vitelline glands.

I hope in the course of the year to publish a more detailed memoir, furnished with figures, upon the points here noticed, and in this I shall furnish more complete statements as to the histological characters of the nervous system and the sense-organs, which cannot well be done here without figures. I will also give the necessary notices of the literature and comparisons with other forms. I have lately received well-preserved material of some other Land-Planariae.

V.—*Descriptions of new Reptiles and Batrachians in the British Museum (Natural History).*—Part III. By G. A. BOULENGER.

Anniella texana.

Head less depressed, snout more rounded than in *A. pulchra*. Nasal shield semidivided, a horizontal suture extending from the nostril to the second labial; frontal twice as broad as long; anterior supraocular nearly as broad as the distance which separates it from its fellow; interparietal and occipital divided (anomalously?) by a longitudinal suture; six upper labials—first very small, below the nasal, second largest and in contact with the præfrontal and a loreal, third